

NOTROPIS AMMOPHILUS, A NEW CYPRINID FISH FROM SOUTH-EASTERN UNITED STATES

ROYAL D. SUTTKUS

MUSEUM OF NATURAL HISTORY, TULANE UNIVERSITY
BELLE CHASSE, LOUISIANA 70037

HERBERT T. BOSCHUNG

DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF ALABAMA
TUSCALOOSA, ALABAMA 35487-0344

ABSTRACT

Notropis ammophilus, a new shiner (Cyprinidae), is described from southeastern United States. It is related to *Notropis longirostris*, *N. sabinae*, and another undescribed form. The distribution of *N. ammophilus*, the orangefin shiner, is primarily below the Fall Line in the Mobile Bay basin in Alabama and Mississippi, in Yellow Creek, a tributary to the Tennessee River in northeastern Mississippi, in the Hatchie River system in southwestern Tennessee and northern Mississippi, and in the Skuna River drainage of the Yazoo River system in northern Mississippi.

The orangefin shiner is more similar to *N. longirostris* in nuptial coloration and tuberculation but more similar to *N. sabinae* in general body shape. These three species plus an additional undescribed form are considered to comprise a species complex by themselves.

INTRODUCTION

Existence of the orangefin shiner, herein described, has been known to ichthyologists for many years. One of the earliest references to this species appeared in Cook (1959). Most authors, including Smith-Vaniz (1968), assumed this form to be an allopatric replacement of *Notropis longirostris* in the Mobile basin. We now know that this form occurs in the headwaters of the Hatchie River system in Mississippi and Tennessee, in tributaries to the south bend of the Tennessee River system, specifically Yellow Creek in northeastern Mississippi, and in the upper Skuna River of the Yazoo

River system in northern Mississippi. The primary purpose of this paper is to formally describe the species and to summarize our field observations.

Notropis longirostris (Hay 1881) was placed in the genus *Alburnops* at the time of its original description and subsequently in *Hybopsis*, as was *Notropis sabinae* Jordan and Gilbert 1886, by Jordan, Evermann and Clark (1930). The type species of *Alburnops* is *Alburnops blennius* Girard (1856: 194) by subsequent designation of Jordan and Gilbert in 1877 (Gilbert, 1978). The type species of *Hybopsis* is *Hybopsis amblops* (Rafinesque 1820: 51) by subsequent designation of Jordan and Gilbert (1877). We do not believe that *Notropis longirostris* is closely related to *N. blennius*. The senior author does not believe that *N. longirostris* is closely related to any of the typical members of the genus *Hybopsis* (*amblops*, *winchelli*, *ammis*, *lineapunctata*, *rubrifrons*, *hypsinotus*) contrary to Mayden's (1989) recent placement of these forms in his grouping of the genus *Hybopsis*. At present we place the new form, together with *Notropis longirostris*, *N. sabinae* and another undescribed species, in a species complex, *longirostris* species group, by themselves. An analysis of the *longirostris* species group will appear in a forthcoming paper. The four species of this group are

characterized by: A pronounced elongate swelling of the rami of the lower jaw that bears tubercles in breeding males; distal portion of anterior rays and interradi al membranes of anal fin of breeding females opaque and more or less (depending on species) flexed dorsally; subterete body shape, dorsal contour arched more than ventral; long, decurved snout; large, inferior, horizontal mouth; typically 8 dorsal fin rays, 7 anal rays, 19 caudal rays, 8—8 pelvic rays, and 12 caudal peduncle scale rows; silvery peritoneum; and psammophilous life style.

The following abbreviations are used: SL = Standard length, CU = Cornell University; GSA = Geological Survey of Alabama; MSU = Mississippi State University; TU = Tulane University, Museum of Natural History; UAIC = University of Alabama Ichthyology Collection; UF = University of Florida, Florida State Museum; UMMZ = University of Michigan, Museum of Zoology; USNM = National Museum of Natural History; and UT = University of Tennessee.

We follow Robins, et al. (1980) with regards to the gender of the genus *Lepomis* and generic groupings of the family Cyprinidae.

Notropis ammophilus, a new species
Orangefin Shiner
Figs. 1—4

Notropis sp. Cook, 1959 (reference to undescribed species in upper Tombigbee and eastward). Smith-Vaniz, 1968 (key, allopatric with *N. longirostris*, Mobile basin endemic). Boschung, 1973, 1984, 1987, 1989 (distribution and abundance in upper Tombigbee). Jenkins, 1976 (undescribed species, distribution). Gilbert, 1980 (distribution). Gilbert and Burgess, 1980 (distribution). Heins et al., 1980 (reproductive biology and habitat). Tim-

mons, 1982 (impoundment of upper Tombigbee). Ramsey, 1984 (distribution and conservation status). Pierson and Schultz, 1984 (distribution and relative abundance in Bull Mountain Creek). Wiley and Mayden, 1985 (distribution). Swift et al., 1986 (distribution). Pierson et al., 1986 (distribution in Buttahatchee River). Mettee et al., 1987 (distribution and abundance in lower Tombigbee). Mettee et al., 1989 (distribution in Black Warrior River system). Pierson et al., 1989 (distribution in Cahaba River system).

Notropis ammophilus. Hubbard, 1987: (*nomen nudum*).

MATERIAL.—The type material consists of 3289 specimens measuring from 17.7 to 48.5 mm in standard length, collected from Chilatchee Creek, a tributary to the Alabama River. Other material examined consists of 41;081 specimens from 1061 collections throughout the range of the species (Fig. 1).

Holotype.—TU 151630, an adult male 48.5 mm standard length, from Chilatchee Creek, trib. Alabama River, 0.3 mi. N Alberta, State Hwy. 5 at Dallas-Wilcox county line, Alabama (T15N, R7E, Sec. 30), on 9 April 1988, collected by Royal D. Suttkus.

Paratypes.—The 124 specimens (TU 151631) collected with the holotype and 14 other series collected at the same site on the following dates: UAIC 265.04 (74), August 30, 1956; UAIC 2362.13 (116), October 11, 1966; TU 60871 (1147), December 18, 1969; UAIC 5899.04 (172), July 23, 1980; TU 121386 (129), May 15, 1981; TU 125388 (292), May 15, 1982; GSA 6865.07 (84), October 19, 1983; TU 140934, May 24, 1985 distributed as follows: TU 140934 (207), CU 71712 (20), UF 78362 (20), UMMZ 214869 (20), UT 44.4504 (20) and USNM 301164 (20);



Fig. 1. *Notropis ammophilus*. Lateral view of a paratype, UAIC 5899.04, male, 44 mm in SL, collected by M. F. Mettee and P. E. O'Neil on July 23, 1980. Photo by P. E. O'Neil.

TU 145519 (117), May 20, 1986; UT 44.4341 (19), May 16, 1988; TU 153083 (98), August 2, 1988; TU 153185 (296), August 3, 1988; TU 154399 (25), February 3, 1989 and TU 154734, May 9, 1989 distributed as follows: TU 154734 (19), UMMZ 215189 (100).

Additional material examined for counts, measurements, pigmentation and/or used for distribution map, totaling 41,081 specimens, in 1,061 collections, are as follows (in parentheses, number of collections followed by number of specimens):

Lower Tombigbee River drainage. ALABAMA. Choctaw County (194 : 16,399), Clarke County (45 : 1000), Marengo County (42 : 4,837), Sumter County (31 : 1,613), Washington County (1 : 99). MISSISSIPPI. Kemper County (3 : 100), Lauderdale County (2 : 94).

Upper Tombigbee River drainage (pre-Tennessee-Tombigbee impoundment). ALABAMA. Fayette County (2 : 14), Franklin County (2 : 34), Greene

County (10 : 714), Lamar County (37 : 368), Marion County (11 : 208), Pickens County (16 : 267), Sumter County (11 : 124), Tuscaloosa County (6 : 30). MISSISSIPPI. Chickasaw County (6 : 1,079), Clay County (11 : 579), Itawamba County (32 : 186), Lee County (7 : 754), Lowndes County (81 : 518), Monroe County (39 : 557), Noxubee County (4 : 41), Oktibbeha County (8 : 224), Pontotoc County (1 : 309), Prentiss County (6 : 161), Tishomingo County (6 : 28), Union County (2 : 2), Webster County (1 : 110), Winston County (5 : 20).

Black Warrior River drainage. ALABAMA. Greene County (4 : 155), Hale County (15 : 560), Tuscaloosa County (28 : 150), Walker County (1 : 1).

Alabama River drainage. ALABAMA. Autauga County (12 : 174), Butler County, (1 : 3), Chilton County (10 : 337), Clarke County (8 : 368), Dallas County (21 : 884), Dallas-Lowndes counties (1 : 63), Elmore County (1 : 1), Lowndes County (2 : 13), Marengo

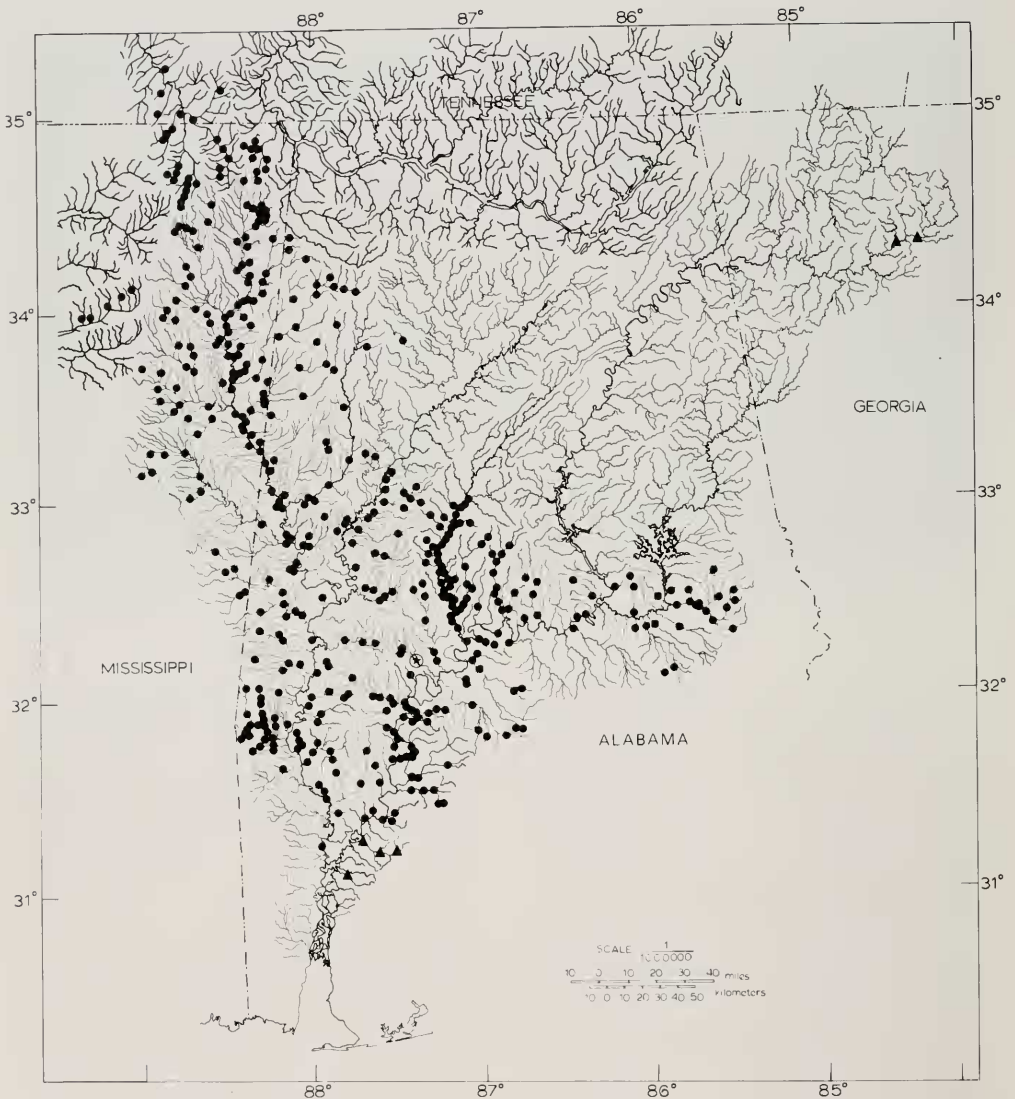


Fig. 2. Distribution by record stations of *Notropis ammodontus* (solid dots), type locality (star in circle) and *Notropis longirostris* in Mobile Bay drainage basin only (solid triangles).

County (3 : 50), Marengo-Dallas counties (1 : 147), Monroe County (33 : 348), Perry County (4 : 41), Wilcox County (137 : 2,183).

Cahaba River drainage. ALABAMA. Bibb County (21 : 476), Dallas County (15 : 302), Perry County (29 : 681).

Coosa River drainage. ALABAMA. Elmore County (4 : 64).

Tallapoosa River drainage. ALABAMA. Bullock County (2 : 65), Elmore County (5 : 43), Lee County (5 : 43), Macon County (21 : 1,662), Montgomery County (3 : 18), Tallapoosa County (1 : 3).

Tennessee River drainage. MISSISSIPPI. Alcorn County (1 : 12), Tishomingo County (15 : 157).



Fig. 3. *Notropis ammophilus*. Lateral view of a specimen from UMMZ 111160, 41 mm in SL. Photo by W. L. Brudon.

Hatchie River drainage. MISSISSIPPI. Alcorn County (4 : 21), Prentiss County (2 : 7), Tippah County (14 : 967), Union County (2 : 16), **TENNESSEE.** Harde-man County (6 : 121), McNairy County (2 : 3).

Yazoo River drainage. MISSISSIPPI. Calhoun County (2 : 109), Pontotoc County (3 : 55).

The locality data for *N. longirostris* and *N. sabiniae* that were used for counts, measurements and description of pig-



Fig. 4. *Notropis ammophilus*. Anterolateral view of head of specimen in Fig. 3. Photo by W. L. Brudon.

mentation are given in the text and in Tables 2 and 3. Collection sites for eleven lots of *N. longirostris* from the Mobile basin as shown on Fig 2. There are six lots from three sites on Little River in Baldwin, Escambia and Monroe counties, Alabama: TU 32554 (1), TU 44400 (6), TU 44414 (14), TU 99939 (15), TU 153958 (7), and UAIC 6528.09 (75). There is one lot from Majors Creek, Baldwin County, Alabama: UAIC 426.02 (6). In addition to these lots from the lower part of the Mobile basin, there are four lots from two sites on the upper Etowah River in Cherokee County, Georgia: UT 44.1940 (8) and UT 44.2157 (6); UT 44.2118 (3) and UT 44.2233 (4).

DIAGNOSIS.—A species of *Notropis* with 4—4 pharyngeal teeth and 7 anal rays. Dorsal fin origin directly over pelvic origin; both dorsal and pelvic fins equal distance between tip of snout and base of caudal fin. Anal fin length of males greater than that of *N. longirostris* and *N. sabinae*. Differs in body proportions from other members of the species complex as seen in Tables 1 and 4. Nuptial males have bright orange fins, orange along lips and on iris (Figure 1).

DESCRIPTION.—In addition to the characters given in the diagnosis, counts and measurements are given to compare *Notropis ammophilus* with *N. longirostris* and *N. sabinae* (Tables 1-4). The pharyngeal teeth are moderately hooked, the edges of the well developed grinding surfaces are entire or weakly crenate, and, in 70 specimens examined, the formula is 4—4. The anal fin ray count is typically 7 (in 96 percent of sample), occasionally 6 (1 percent) or 8 (3 percent), where $N = 100$. The dorsal fin ray count is almost always 8 (98 percent of sample), rarely 9 (2 percent), where $N = 100$. Pelvic fin rays typically number 8—8 (92 percent of sample), oc-

casionally 7—8 (2 percent), 8—7 (3 percent) or 8—9 (3 percent), where $N = 100$. The principal caudal rays number 19 (94 percent of sample), 18 (1 percent), and 20 (5 percent), where $N = 100$. Caudal peduncle scale rows, numbering 12 in the entire sample of 100 specimens, consist of 5 rows each above and below the lateral line. Other scale counts are given in Table 2. The Weberian apparatus, consisting of 4 vertebrae, and the single urostylar vertebra were included in the total vertebral count. *Notropis ammophilus* usually has 34 or 35 vertebrae (Table 3).

Measurements of the holotype are detailed in Table 1 and its fin ray and scale counts are as follows: D 8, A 7, P 14, V 8, C 19, lateral line scales 34, caudal peduncle scales 12, body circumferential scales 24, and predorsal diagonal scale rows 14.

The subterete body form, with a decidedly arched dorsal profile and only slightly curved venter, is well adapted to the benthic habitat. The body is moderately robust anteriorly but tapers rather abruptly posterior to the dorsal fin. The mouth is inferior and nearly horizontal to slightly angled. The dorsal fin is moderately elevated and its anterior rays are usually longer than the posterior ones of the depressed fin; the posterior margin is nearly straight, or it may describe a shallow sigmoid curve. The anal fin is less elevated than the dorsal, particularly that of the females, and its posterior margin also describes a sigmoid curve. The anterior rays of the anal fin, even the flexed rays of females, are usually longer than the posterior ones of the depressed fin. Other fins are typical in shape and size for small shiners. Usually the pectorals are more expansive in the males than in females.

Only males have well developed

TABLE 1. Proportional Measurements (Expressed in Thousandths of Standard Length) for *Notropis ammophilus*, *N. longirostris* and *N. sabinae*.

Character	Holotype	<i>N. ammophilus</i>				<i>N. longirostris</i>				<i>N. sabinae</i>			
		10 Males		10 Females		10 Males		10 Females		10 Males		10 Females	
		Range	\bar{x}	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}	Range	\bar{x}
Standard length (mm)	48.5	42.5-45.4	43.6	43.3-47.1	45.2	48.7-55.9	52.8	51.1-57.8	54.2	41.2-48.1	44.0	44.4-47.7	46.3
Dorsal origin to snout tip	515	499-519	509	494-518	509	477-499	489	481-507	494	492-518	502	487-504	496
Dorsal origin to caudal base	519	514-539	527	511-535	519	522-545	533	524-548	535	532-554	543	527-563	548
Dorsal origin to occiput	295	276-305	296	277-296	293	283-301	294	287-311	298	269-297	283	274-292	282
Pelvic insertion to snout tip	509	498-526	509	501-527	514	462-486	478	474-495	485	474-495	482	470-503	484
Anal origin to caudal base	346	339-363	349	317-349	333	341-373	363	340-364	353	351-398	380	362-380	371
Body depth	229	209-236	220	240-266	251	180-201	188	183-215	191	225-246	237	224-243	236
Body width	155	136-148	140	163-188	177	129-140	134	127-143	136	145-163	156	148-167	161
Caudal peduncle length	235	222-240	232	229-245	237	232-258	245	235-267	251	233-255	243	228-252	242
Caudal peduncle depth	109	108-117	112	99-115	109	98-109	103	95-108	100	122-129	125	118-126	122
Head length	266	261-283	273	263-279	270	230-247	239	229-250	241	258-277	267	261-285	271
Head depth	165	162-176	167	167-182	174	137-145	142	140-150	144	165-184	176	169-182	177
Head width	152	144-159	152	155-177	164	124-133	130	124-140	131	148-166	159	149-159	154
Interorbital least fleshy	89	87-94	90	85-94	90	74-80	76	72-81	75	90-99	94	86-93	89
Snout length	97	92-99	96	88-99	94	78-87	81	78-87	82	96-104	101	96-105	99
Eye length	68	68-70	69	66-70	68	57-62	60	57-62	60	66-71	69	66-70	68
Upper jaw length	86	85-97	92	88-95	91	74-84	79	78-82	81	84-91	87	89-95	92
Dorsal fin length	206	207-233	222	202-231	215	180-200	191	181-196	188	203-233	220	200-231	218
Anal fin length	169	181-216	190	155-174	166	152-168	162	135-158	146	157-175	164	150-170	159
Caudal fin length	251	251-281	267	249-282	264	241-279	258	240-276	259	269-306	286	252-293	276
Pectoral fin length	165	164-190	180	166-189	176	154-182	172	160-186	171	161-179	170	170-183	174
Pelvic fin length	146	143-159	152	139-155	147	127-141	134	126-144	135	144-157	150	139-150	145

TABLE 3. Number of Vertebrae in *Notropis ammophilus*, *N. longirostris* and *sabinae*.

Species and system	Number of Vertebrae					N	\bar{x}
	33	34	35	36	37		
<i>N. ammophilus</i>							
Alabama River	1	51	54	3		109	34.54
Tennessee River		6	15	2		23	34.83
Hatchie River	1	17	17	1		36	34.50
	2	74	86	6		168	34.57
<i>N. longirostris</i>							
Pascagoula River			6	47	21	74	36.20
<i>N. sabinae</i>							
Sabine River	5	71	40	1	2	119	34.36

nuptial tubercles. Some females have a few minute tubercles on the top of the head but the remainder of the body is devoid of tubercles. The largest tubercles are scattered over the dorsal surface of the head where they are double in size from the internarial area to the occiput. There is a single row of large tubercles, more or less evenly arranged, over the supraorbital rim. Minute tubercles cover the snout and are scattered between the larger ones on top of the head. Some males have minute tubercles extending to the lachrymal area and to the upper parts of the opercular region. The head tuberculation, as we have described it above, agrees reasonably well with the description of Heins et al. (1980) for specimens from Uphapee Creek. Multiple rows of small tubercles are present on the pectoral fin rays, and their number diminish toward the posterior rays. Nuptial males have tubercles on the first seven to nine pectoral rays. Some nuptial males taken in May have tubercles on the leading edge of the dorsal fin, the anal fin, and on the upper and lower caudal fin margins. In addition, a few males have tubercles on the predorsal and anterolateral scales. The typical intermediate tubercular pattern shows tuberculate ridges on the lower jaw, a few tubercles on the leading edge of the dorsal fin, the upper and

lower margin of the caudal fin, and the lower two or three branched caudal rays.

The lateral line system is usually complete. Rarely is the last scale of the lateral line unpored. The lateral line is nearly straight, with only a slight dip anteriorly; above the pelvic fin insertion, it gradually angles dorsally and then levels at the midlateral area of the caudal peduncle.

COLORATION.—The orangefin shiner, when not in nuptial attire, is a pale, very lightly pigmented fish. The prevalent pigmentation of preserved specimens is the dark spots above and below each lateral line pore. The spots are prominent anteriorly but often blend with the lateral stripe on the caudal peduncle. The short lateral stripe begins on the lateral area above the insertion of the anal fin, and it extends posteriorly to the base of the caudal fin. The pigmentation of the stripe is somewhat imbedded and is just ventral to the lateral line pigmentation. In most specimens, the lateral line pigment spots are superimposed on the upper margin of the lateral stripe. Some specimens have an additional row of paired spots on the scale row above the lateral line, thus giving the appearance of a double lateral line on the anterior part of the body. There is a thin submarginal line of pig-

TABLE 4. Comparison of *Notropis amnophilus*, *N. longirostris* and *N. sabinae*.

Character	(Measurements of males, expressed in Thousandths of Standard Length)		
	<i>amnophilus</i>	<i>longirostris</i>	<i>sabinae</i>
Position of dorsal fin insertion	Nearly midway between snout and caudal base	Slightly anterior to midway	Anterior to midway
Position of pelvic fin insertion	Nearly midway between snout and caudal base	Anterior to midway	Anterior to midway
Position of anal origin in females	Nearest to caudal base	Farther from caudal base	Farthest from caudal base
Depth of caudal peduncle	Deep 108-117 (112)	Slim 98-109 (103)	Deepest 122-129 (125)
Length of head	Moderate 261-283 (273)	Shortest 230-247 (239)	Moderate 258-277 (267)
Depth of head	Moderate 162-176 (167)	Least 137-145 (142)	Moderate 165-184 (176)
Width of head	Moderate 144-159 (152)	Narrowest 124-133 (130)	Moderate 148-166 (159)
Interorbital least fleshy	Moderate 87-94 (90)	Narrowest 74-80 (76)	Moderate 90-99 (94)
Length of snout	Intermediate 92-99 (96)	Shortest 78-87 (81)	Longest 96-104 (101)
Length of eye	Moderate 68-70 (69)	Smallest 57-62 (60)	Moderate 66-71 (69)
Length of upper jaw	Moderate 85-97 (92)	Shortest 74-84 (79)	Moderate 84-91 (87)
Dorsal fin length	Moderate 207-233 (222)	Shortest 180-200 (191)	Moderate 203-233 (220)
Anal fin length in males	Longest 181-216 (190)	Shortest 152-168 (162)	Intermediate 157-175 (164)
Anal fin, length of anterior rays in depressed fin	Subequal or longer than posterior rays	Subequal or longer	Shorter
Pelvic fin length	Moderate 143-159 (152)	Shortest 127-141 (134)	Moderate 144-157 (150)
Breeding colors	Usually orange	Usually yellow, sometimes orange	Plain, no bright yellow or orange
Distribution of large tubercles on head of male	Scattered over top of head	Scattered over top of head	In compact clusters on end of snout, lachrymal and preorbital areas, less compact on interorbital and interorbital.
Presence of large tubercles on head of female	None	None	Slightly to moderately developed on end of snout and lachrymal area.
Breast scales	None	Imperfectly scaled; a few prepectoral and between pelvic bases.	None
Mental symphyseal bib	None	None	Usually present, nuptial males and gravid females.
Pharyngeal teeth	4-4	4-4 to 1,4-4,1	4-4

ment on the scales of the lateral line and at least on two rows above the lateral line. Most of the dorsal and dorsolateral scales also have the thin submarginal line of pigment but other melanophores are clustered just anterior to the submarginal "string" and tend to obscure the fine submarginal line, particularly on the middorsal scales. Ventral to the lateral line, the melanophores of the scales' submarginal line become more disconnected and disappear completely on the belly. Most scales, except for a few in the middorsal area, have a non-pigmented anterior central area, thus emphasizing the submarginal pigmentation.

With magnification, a thin band (lateral stripe) of deeply imbedded melanophores is discernable from the central area of the scale row above the anterior part of the lateral line posteriorly in a straight line to near the base of the caudal fin. Because of the anterior dip of the lateral line, the thin band is separated from the lateral line by a distance approximately equal to the depth of a nearby scale, but it is just above the lateral line on the caudal peduncle. There is a thin middorsal stripe before and after the dorsal fin. There are some melanophores along the base of the anal fin that continue posteriorly as a faint midventral caudal peduncle stripe.

The dark pigmentation on top of the head diminishes in intensity from the occiput to the internarial area and snout. There is a moderate amount of pigmentation on the upper part of the opercle, and on the preorbital area where it forms a thin band bordering the suborbital rim. The lips, lower cheek, opercle, gular area, breast, and belly are devoid of pigmentation. The dorsal fin rays, some anal rays of some individuals, and caudal fin rays are

more or less margined with melanophores. The pectoral and pelvic fins are essentially immaculate. The basal part of the caudal rays are margined with melanophores, but distally there are few or none. Melanophores at the base of the caudal rays tend to form a dusky spot which is not readily visible with the unaided eye.

Breeding coloration is the basis for the suggested common name, orangefin shiner. Males in "high" nuptial condition have bright orange fins. In some males the fins are reddish orange. The leading edges of the paired fins, the dorsal and anal fins, and the upper and lower margins of the caudal fin are milky white. The snout is pinkish orange and the upper and lower lips are bright orange. The iris is orange, particularly its dorsal part. Females, pallid compared with males, lack coloration on the fins, but have weak yellow-orange color on the snout, lips and upper part of the iris. Brightly colored male specimens were observed in early April through early August. Some male specimens collected in late May had brightly colored fins but were only slightly tuberculate, whereas, others of the same color intensity had fully developed tubercles.

ETYMOLOGY.—This fish, as stated above, has been known for many years and *ammophilus* was a manuscript name applied in 1939 by the late Carl L. Hubbs. The name is derived from the Greek *amos*, sand, and *philo*, to love, in reference to the preferred habitat.

COMPARISONS.—Characteristics common to *Notropis ammophilus*, *N. longirostris* and *N. sabinae* are given in the diagnosis of the species complex. The proportions in Table 4 reflect the shorter body of *N. ammophilus* and *N. sabinae* versus the elongate body of *N. longirostris*. The general body shape of *N. ammophilus* is similar to that of *N. sabinae*. *Notropis longirostris* is less

robust anteriorly and its dorsal profile tapers less abruptly than that of the other two species. *Notropis ammophilus* and *N. longirostris* are similar in head tuberculation and breeding colors. *Notropis ammophilus* and *N. sabinae* have the same pharyngeal tooth formula of 4—4 whereas *N. longirostris* is variable in number. The tooth in the minor row of *N. longirostris*, when present, is usually very slender, fragile, and slanted toward the teeth of the major row. Undoubtedly this fragile tooth is sometimes lost during removal of arch or cleaning; however, some individuals do lack teeth in the minor. Pharyngeal arches of *N. longirostris* were removed from 20 specimens from each of five drainages from the Yellow River in Florida to the Amite River in Louisiana. The pharyngeal tooth formula was 0,4—4,0 in 35 specimens and 1,4—4,1 in 32 specimens. Thirty specimens had either 0,4—4,1 or 1,4—4,0. Of the remaining three specimens, one had the formula 0,4—3,0, one 0,4—5,0 and the other 0,5—4,0. *N. longirostris* (Biloxi River sample) has somewhat higher lateral line scale and predorsal diagonal scale row counts and a higher vertebral count (Pascagoula River sample) than the other two species (Tables 2 and 3); however, *N. longirostris* has the lowest body circumferential scale count. A more complete analysis of *N. longirostris* populations will appear in a future paper.

GEOGRAPHICAL VARIATION.—*Notropis ammophilus* does not vary significantly throughout its range. The Hatchie River and the Yazoo River specimens vary slightly from the Alabama River specimens in scale and fin ray counts (Table 2). Based on recent observations, the nuptial coloration of Hatchie and Yazoo system specimens is identical with that displayed by Tombigbee and Alabama system specimens.

HABITAT AND BIOLOGY.—*Notropis ammophilus* usually inhabits small to large streams offering the ideal habitat

of clear water and a substrate of clean sand. It does occupy substrates of silt covered sand, mixtures of sand and fine gravel, or hard clay. Chilatchee Creek, the type locality, is typical habitat. The stream varies in width from 6 to 15 meters or greater, and depths from 0.1 to 0.45 meters, depending on the season. We have observed, as did Heins et al. (1980), that fairly extensive, gently sloping sand and gravel bars line the margins of preferred stream habitats. The species will occupy much smaller streams that are near the confluence of a major stream. A few specimens at various times have been collected in the main channel of the Alabama and upper Tombigbee rivers.

Notropis ammophilus is a gregarious species and, in its typical habitat, forms schools of hundreds of individuals. A school of fish will swim slowly upstream for a short distance and then more or less drift downstream while moving in and out of depressions such as troughs on the lee side of snags. Spawning was observed on numerous occasions. It occurred in the shallows and in the manner of *Notropis longirostris* as described by Hubbs and Walker (1942); however, in no instance did we attempt to follow the activities of a particular male as they reported. Based on observations spawning extended from May through August.

Chilatchee Creek, the type locality, is relatively rich in species. The following 14 species were collected with the holotype: *Campostoma oligolepis*, *Ericymba buccata*, *Notropis bellus*, *N. venustus*, *Pimephales notatus*, *Noturus nocturnus*, *Gambusia affinis*, *Lepomis cyanellus*, *L. macrochirus*, *L. megalotis*, *Etheostoma* sp., *E. nigrum*, *E. rupestre*, and *E. stigmaeum*. Twelve additional collections from the type locality yielded: *Carpiodes velifer*, *Erimyzon oblongus*, *Minytrema melanops*,

Moxostoma erythrurum, *M. poecilurum*, *Hybopsis winchelli*, *Notemigonus crysoleucas*, *Notropis stilbius*, *N. texanus*, *N. volucellus*, *Pimephales vigilax*, *Sem otilus atromaculatus*, *Ictalurus punctatus*, *Noturus gyrinus*, *N. leptacanthus*, *Fundulus olivaceus*, *Ambloplites ariommus*, *Lepomis gulosus*, *L. microlophus*, *L. punctatus*, *Micropterus punctulatus*, *M. salmoides*, *Pomoxis nigromaculatus*, *Etheostoma parvipinne*, *E. whipplei*, *E. zoniferum*, *Percina maculata* and *P. nigrofasciata*. Thus, we have a total of 43 species from the type locality.

An analysis, of the 12,156 fish collected in 13 samples (excluding the 1989 samples) from Chilatchee Creek reveals some interesting information regarding abundance and frequency of occurrence. *Notropis ammophilus* numbered 2976 (24.5 percent of sample), the highest in relative abundance. Next most abundant was *Pimephales notatus* (2837 specimens, 23.3 percent), another bottom dwelling fish. There were two common mid-water species: *Notropis venustus* (1952 specimens, 16.1 percent) and *N. bellus* (1667 specimens, 13.7 percent). Thus, the two mid-water species (3619 specimens) represented 29.8 percent, and the two bottom species (5818 specimens) represented 47.8 percent of all specimens collected. These four species (9437 specimens) represented 77.6 percent of the total, and the remaining 39 species represented 22.4 percent.

RANGE.—*Notropis ammophilus* is widely distributed in the Mobile basin, essentially below the Fall Line (Fig. 2). Disjunct populations occur in the Yellow Creek system, a relatively small watershed of the Tennessee drainage in northern Mississippi, in the headwaters of the Hatchie River system in northern Mississippi and southwestern Tennessee, and in the Skuna River system of the Yazoo drainage in northern Mississippi. *Notropis longirostris* is absent from

nearly the entire range of *N. ammophilus*; however, there are populations of *N. longirostris* in Little River and Majors Creek which are eastern tributaries to the Alabama River in the lower part of the Mobile basin (Fig. 2). No *N. ammophilus* specimens have been taken in either of these two tributaries. Perhaps the parapathy is the result of human activities, but more likely it is the result of a natural faunal interchange between the Little River and the Escambia River system at some time in the past when the two systems were connected. There are also populations of *N. longirostris* in the upper Etowah River in northern Georgia. These populations are well above the Fall Line and far above the uppermost populations of *N. ammophilus* in the lower Coosa River (Fig. 2). We believe the Etowah River population also to be of natural occurrence and presume that lateral headwater tributaries of the Etowah and the Chattahoochee rivers were at one time connected.

ACKNOWLEDGMENTS

Study materials and distributional records of *Notropis ammophilus* have been accumulating over the years, due to a large extent to the efforts of graduate students and colleagues at Tulane University, University of New Orleans, Mississippi State University, and the University of Alabama, who have contributed in a very significant way to the study of southeastern fishes. They are in alphabetical order: Paul K. Anderson, James G. Armstrong, Clyde D. Barbour, Eugene C. Beckham, Meredith May Blackwell, Lyn Branch, Richard D. Caldwell, John H. Caruso, Robert C. Cashner, Glenn H. Clemmer, Veronica Trau Colbert, John Van Conner, Michael D. Dahlberg, Keith G. Goodfellow, Gerald E. Gunning, Charles D.

Hancock, Hector Harima, David C. Heins, Henry H. Howell, W. Mike Howell, Julian Humphries, Maurice F. Mettee, Rudolph J. Miller, Phillip R. Mundy, Patrick E. O'Neil, John Pagels, J. Malcolm Pierson, John S. Ramsey, Sharon E. Reilly, Kenneth Relyea, Dawn E. Remington, Steven O. Rohmann, Patrick Sorensen, Diana W. Stein, Mark Stevens, Jamie E. Thomerson, Bruce A. Thompson, Charles E. Tucker, Benjamin R. Wall, James D. Williams.

We thank David Etnier for loan of specimens from the Hatchie and Etowah River systems. We are grateful to Richard L. Mayden who made available the extensive UAIC data and to Maurice F. Mettee and Patrick E. O'Neil who furnished the extensive GSA data, and to J. Malcolm Pierson for data from the Cahaba River. Frank J. Pezold (Mississippi State University) made MSU data available. We extend our sincere thanks to Glenn H. Clemmer who assisted in many of the early collections and is responsible for most of the accumulated material at MSU. He also assisted in making vertebral counts. Reeve M. Bailey reviewed a draft of this paper and offered helpful suggestions, also he graciously withdrew from an early considered co-authorship. Moreover, we are indebted to Reeve M. Bailey for UMMZ collection data and for the use of photographs (Figs. 3-4) that were prepared by William L. Brudon and to Patrick E. O'Neil for the use of his color photograph (Fig. 1).

LITERATURE CITED

- BOSCHUNG, H. T. 1973. A report on the fishes of the upper Tombigbee River, Yellow and Indian creek systems of Alabama and Mississippi. First Supplemental Report, Continuing Environmental Studies. Vol. 7. Appendix C. Army Corps of Engineers, Mobile District, Mobile, Ala., 144 p. + appendix.
- BOSCHUNG, H. T. 1984. A study of the fishes of the upper Tombigbee River drainage system south of the Columbus Lock and Dam Tennessee-Tombigbee Waterway: U.S. Army Corps of Engineers, Mobile District, Mobile, Ala., 194 p. + appendix.
- BOSCHUNG, H. T. 1987. Physical factors and the distribution and abundance of fishes in the upper Tombigbee River system of Alabama and Mississippi, with emphasis on the Tennessee-Tombigbee Waterway. pp. 184-192 in: Matthews, W. J. and D. C. Heins (eds.). Community and Evolutionary Ecology of North American Stream Fishes. University of Oklahoma Press, Norman, Okla., 310 p.
- BOSCHUNG, H. T. 1989. Atlas of fishes of the upper Tombigbee River drainage, Alabama-Mississippi. Southeastern Fishes Council 19: 104 p.
- COOK, F. A. 1959. Freshwater Fishes in Mississippi. Miss. Game and Fish Comm., Jackson, 239 p.
- GILBERT, C. R. 1978. Type catalogue of the North American cyprinid fish genus *Notropis*. Bull. Florida State Mus. Biol. Sci. 23(1): 104 p.
- GILBERT, C. R. 1980. *Notropis sabiniae* Jordan and Gilbert, Sabine shiner, p. 304 in: Lee, D. S., et al. Atlas of North American freshwater fishes. N.C. State Mus. of Nat. Hist., 867 p.
- GILBERT, C. R., and G. H. BURGESS. 1980. *Notropis longirostris* (Hay), longnose shiner, p. 283 in: Lee, D. S., et al. Atlas of North American freshwater fishes. N.C. State Mus. of Nat. Hist., 867 p.
- GIRARD, C. 1856. Researches upon the cyprinoid fishes inhabiting the fresh waters of the United States, west of the Mississippi Valley, from specimens in the museum of the Smithsonian Institution. Proc. Acad. Nat. Sci. Phila. 8(5): 165-213. (also printed as a separate. 1856: 54 p.).
- HAY, O. P. 1881. On a collection of fishes from eastern Mississippi. Proc. U.S. Nat. Mus. (1880)3: 488-515.
- HEINS, D. C., G. E. GUNNING, and J. D. WILLIAMS. 1980. Reproduction and population structure of an undescribed species of *Notropis* (Pisces: Cyprinidae) from the Mobile Bay drainage, Alabama. Copeia, 1980(4): 822-830.
- HUBBARD, W. D. 1987. Distribution and diversity of fishes in the Noxubee River drainage, Mississippi. Jour. Mississippi Acad. Sci. 32: 19-29.
- HUBBS, C. L., and B. W. WALKER. 1942. Habitat and breeding behavior of the American cyprinid fish *Notropis longirostris*. Copeia, 1942(2): 101-104.
- JENKINS, R. E. 1976. A list of undescribed freshwater fish species of continental United States and Canada, with additions to the 1970 checklist. Copeia, 1976(3): 642-644.
- JORDAN, D. S., B. W. EVERMANN, and H. W. CLARK. 1930. Checklist of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. Rept. U.S. Fish Comm. (1928) (Appendix X): 670 p.

- JORDAN, D. S. and C. H. GILBERT. 1877. On the genera of North American freshwater fishes. *Proc. Acad. Nat. Sci. Phila.* 29: 83-104.
- JORDAN, D. S., and C. H. GILBERT. 1887. List of fishes collected in Arkansas, Indian Territory, and Texas, in September, 1884. with notes and descriptions. *Proc. U.S. Nat. Mus.* 9: 1-25.
- LEE, D. S., C. R. GILBERT, C. H. HOCUTT, R. E. JENKINS, D. E. MCALLISTER, and J. R. STAUFFER, JR. 1980. Atlas of North American freshwater fishes. N.C. State Mus. of Nat. Hist., Raleigh. x + 867 p.
- MAYDEN, R. L. 1989. Phylogenetic studies of North American minnows, with emphasis on the genus *Cyprinella* (Teleostei: Cypriniformes). *Univ. Kansas Mus. Nat. Hist., Misc. Publ.* 80: 189 p.
- METTEE, M. F., P. E. O'NEIL, J. J. PIERSON, and R. D. SUTTKUS. 1989. Fishes of the Black Warrior River system in Alabama. *Alabama Geological Survey, Bull.* 133: 201 p.
- METTEE, M. F., P. E. O'NEIL, R. D. SUTTKUS, and J. M. PIERSON. 1987. Fishes of the lower Tombigbee River system in Alabama and Mississippi. *Alabama Geological Survey, Bull.* 107: 186 p.
- PIERSON, J. M., W. M. HOWELL, R. A. STILES, M. F. METTEE, P. E. O'NEIL, R. D. SUTTKUS and J. S. RAMSEY. 1989. Fishes of the Cahaba River system in Alabama. *Alabama Geological Survey, Bull.* 134: 183 p.
- PIERSON, J. M., and C. A. SCHULTZ. 1984. A report on the fishes of Bull Mountain Creek, with comments on the status of rare species. *Proc. Southeastern Fishes Council* 4(3): 1-3.
- PIERSON, J. M., C. A. SCHULTZ, and H. T. BOSCHUNG. 1986. Fishes of the Buttahatchee River system of Alabama and Mississippi. *Proc. Southeastern Fishes Council* 4(4): 11-13.
- RAFINESQUE, C. S. 1820. *Ichthyologia Ohiensis*, or natural history of the fishes inhabiting the River Ohio and its tributary streams, preceded by a physical description of the Ohio and its branches. W. G. Hunt, Lexington, Ky., 90 p.
- RAMSEY, J. S. 1985. Freshwater Fishes. *in*: R. H. Mount, ed. *Vertebrate Wildlife of Alabama*, Auburn University, 44 p.
- ROBINS, C. R., R. M. BAILEY, C. E. BOND, J. R. BROOKER, E. A. LACHNER, R. N. LEA, and W. B. SCOTT. 1980. A list of common and scientific names of fishes from the United States and Canada: American Fisheries Society Special Publication 12, 174 p.
- SMITH-VANIZ, W. F. 1968. Freshwater fishes of Alabama. *Agri. Exp. Stat., Auburn Univ., vii* + 211 p.
- SWIFT, C., C. R. GILBERT, S. A. BORTONE, G. H. BURGESS, and R. W. YERGER. 1986. Chap. 7, pp. 213-266. *in*: *The Zoogeography of North American Freshwater Fishes*. C. H. Hocutt, and E. O. Wiley (eds.). John Wiley and Sons, xiii + 866 p.
- TIMMONS, T. J. 1982. Initial changes in fish species composition in two new lakes of the Tennessee-Tombigbee Waterway, Alabama-Mississippi. *Proc. Southeastern Fishes Council* 4(1): 1-4.
- WILEY, E. O., and R. L. MAYDEN. 1985. Species and speciation in phylogenetic systematics, with examples from the North American fish fauna. *Ann. Missouri Bot. Gard.* 72: 596-635.